CLAIMS

1. A display device comprising:

first electrodes classified into a plurality of groups;

second electrodes respectively provided so as to cross said first electrodes;

a display panel comprising a plurality of capacitive light emitting elements respectively provided at intersections of said first electrodes and said second electrodes; and

a drive circuit that applies a data pulse for light-emitting the selected capacitive light emitting element to the first electrodes in said plurality of groups such that phase differences respectively occur between said plurality of groups,

said drive circuit comprising

a recovering capacitive element,

an application circuit that discharges charges to said first electrodes from said recovering capacitive element or recovers the charges from said first electrodes in said recovering capacitive element, to apply a driving pulse for applying the data pulse to said first electrodes, and

a potential limiting circuit that limits the quantity of the charges recovered in said recovering capacitive element, to limit a potential of said recovering capacitive

element so as not to exceed a predetermined value.

2. A display device comprising:

first electrodes classified into a plurality of groups;

second electrodes respectively provided so as to cross said first electrodes;

a display panel comprising a plurality of capacitive light emitting elements respectively provided at intersections of said first electrodes and said second electrodes; and

a drive circuit that applies a data pulse for light-emitting the selected capacitive light emitting element to the first electrodes in said plurality of groups such that phase differences respectively occur between the plurality of groups,

said drive circuit comprising

an inductive element,

a recovering capacitive element,

an application circuit that discharges charges to said first electrodes from said recovering capacitive element by a resonance operation of a capacitance of said display panel and said inductive element or recovers the charges in said recovering capacitive element from said first electrodes through said inductive element, to apply to said first node a driving pulse for applying the data pulse to the first

electrodes in said plurality of groups, and

a potential limiting circuit that limits the quantity of the charges recovered in said recovering capacitive element, to limit a potential of said recovering capacitive element so as not to exceed a predetermined value.

3. A display device comprising:

first electrodes classified into a plurality of groups;

second electrodes respectively provided so as to cross said first electrodes;

a display panel comprising a plurality of capacitive light emitting elements respectively provided at intersections of said first electrodes and said second electrodes; and

a drive circuit that applies a data pulse for light-emitting the selected capacitive light emitting element to the first electrodes in said plurality of groups such that phase differences respectively occur between said plurality of groups,

said drive circuit comprising

a first power supply terminal receiving a first power supply voltage,

an inductive element,

a recovering capacitive element,

an application circuit that discharges charges from

said recovering capacitive element by a resonance operation of a capacitance of said display panel and said inductive element to raise a potential at a first node, connects said first node and said first power supply terminal to each other, then disconnects said first node and said first power supply terminal from each other, and recovers the charges in said recovering capacitive element from said first node through said inductive element by said resonance operation to lower the potential at said first node, to apply to said first node a driving pulse for applying the data pulse to the first electrodes in said plurality of groups, and

a potential limiting circuit that limits the quantity of the charges recovered in said recovering capacitive element, to limit a potential of said recovering capacitive element so as not to exceed a predetermined value lower than said first power supply voltage.

4. The display device according to claim 3, wherein the inductive element is provided between said first node and a second node,

said recovering capacitive element is connected to a third node,

said potential limiting circuit limits a potential at said third node, to limit the potential of said recovering capacitive element so as not to exceed said predetermined

value,

said application circuit comprises

a first switching element provided between said first power supply terminal and said first node,

a second switching element provided between a ground terminal receiving a ground potential and said first node,

a third switching element provided between said second node and said third node, and

a fourth switching element provided between said second node and said third node, and

in an address time period during which said selected capacitive light emitting element in said display panel is to be light-emitted, the third switching element is turned on so that the charges are discharged into said first node from said recovering capacitive element through said inductive element, the potential at said first node is raised, said third switching element is turned off and said first switching element is turned on so that the potential at said first node is raised to said first power supply voltage, and said first switching element is turned off and said fourth switching element is turned on so that the charges are recovered in said recovering capacitive element from said first node through said inductive element so that the potential at said first node is lowered, thereby generating said driving pulse.

5. The display device according to claim 3, wherein said drive circuit further comprises first switching circuits respectively provided in correspondence with said first electrodes, and is operated such that

said first switching circuit is turned on so that the charges are recovered and discharged between said first node and said first electrode, and said first switching circuit is turned off so that said corresponding first electrode is set to the ground potential.

6. The display device according to claim 4, wherein said potential limiting circuit comprises

a division circuit that divides a voltage between said first power supply voltage and the ground potential to produce a potential approximately equal to said predetermined value, and

a second switching circuit connected between said third node and said ground terminal and receiving the potential produced by said division circuit as a control signal, and turned on when the potential at said third node exceeds said predetermined value.

7. The display device according to claim 4, wherein said potential limiting circuit comprises

a second power supply terminal receiving a second power supply voltage approximately equal to said predetermined value, and

a second switching circuit connected between said third node and said ground terminal and receiving said second power supply voltage received by said second power supply terminal as a control signal, and turned on when the potential at said third node exceeds said predetermined value.

8. The display device according to claim 6, wherein said second switching circuit comprises

a unidirectional conductive element provided between said third node and a fourth node and causing a current to flow from said third node to said fourth node, and

a fifth switching element provided between said fourth node and said ground terminal, and having a control terminal receiving said control signal.

9. The display device according to claim 4, wherein said potential limiting circuit comprises

a unidirectional conductive element provided between said third node and said ground terminal and causing a current to flow from said third node to said ground terminal when the potential at said third node exceeds said predetermined value.

10. The display device according to claim 9, wherein said unidirectional conductive element is a zener diode.

11. The display device according to claim 4, further comprising a charge pump circuit that produces a potential higher than the potential at said first node in order to turn said first switching element on.

12. The display device according to claim 11, wherein said charge pump circuit comprises

a charging capacitive element provided between said first node and a fifth node,

a unidirectional conductive element provided between a third power supply terminal receiving a third power supply voltage and said fifth node and causing a current to flow from said second power supply terminal to said fifth node, and

a control signal output circuit that adds a potential at said fifth node to the potential at said first node, and outputting a potential obtained by the addition to said first switching element as a control signal.

13. The display device according to claim 3, wherein said predetermined value is more than one-second said first power supply voltage and is not more than four-fifth said

first power supply voltage.

14. The display device according to claim 3, wherein said phase difference is not less than 200 ns.

15. The display device according to claim 3, further comprising

a plurality of drive circuits,

said plurality of drive circuits being respectively provided in correspondence with said plurality of groups, and

said plurality of drive circuits respectively applying the data pulses for light-emitting the selected capacitive light emitting element to said first electrodes in said plurality of groups such that phase differences respectively occur between said plurality of groups.

16. The display device according to claim 3, further comprising

a number-of-times detector for detecting the number of times of rise or the number of times of fall of the data pulse applied to said first electrodes,

said drive circuit further comprising

a controller for calculating the ratio of said number of times detected by said number-of-times detector to the maximum number of times the data pulse can rise or the number

of times the data pulse can fall, lowering, when said ratio is more than a predetermined ratio value, the potential at said first node to a predetermined voltage value, and then controlling the operation of said application circuit such that said first node is grounded.

17. The display device according to claim 16, further comprising

a converter for converting, in order to divide one field into a plurality of sub-fields and discharge said capacitive light emitting element selected for each of the sub-fields to perform gray scale expression, image data corresponding to the one field into image data corresponding to the sub-field,

said number-of-times detector detecting said number of times for each of the sub-fields on the basis of the image data fed from said converter,

said controller calculating the ratio of said number of times obtained by said number-of-times detector to the maximum number of times the data pulse in each of the sub-fields can rise or the maximum number of times the data pulse can fall, lowering, when said ratio is more than the predetermined ratio value, the potential at said first node to the predetermined voltage value, and then controlling the operation of said application circuit such that said first

node is grounded.

18. The display device according to claim 16, wherein said predetermined ratio value is not less than 95 %.

19. A method of driving a display device comprising first electrodes classified into a plurality of groups, second electrodes respectively provided so as to cross said first electrodes, and a display panel comprising a plurality of capacitive light emitting elements respectively provided at intersections of said first electrodes and said second electrodes, comprising the step of:

respectively applying a data pulse for light-emitting the selected capacitive light emitting element to the first electrodes in said plurality of groups such that phase differences respectively occur between said plurality of groups,

the step of applying the data pulse comprising the steps of

discharging charges from a recovering capacitive element by a resonance operation of a capacitance of said display panel and an inductive element to raise a potential at a first node, connecting said first node and a first power supply terminal to each other, then disconnecting said first node and said first power supply terminal from each other,

and recovering the charges in said recovering capacitive element from said first node through said inductive element by said resonance operation to lower the potential at said first node, to apply to said first node a driving pulse for applying the data pulse to the first electrodes in said plurality of groups, and

limiting the quantity of the charges recovered in said recovering capacitive element, to limit a potential of said recovering capacitive element so as not to exceed a predetermined value lower than said first power supply voltage.

20. The method of driving the display device according to claim 19, further comprising the steps of

detecting the number of times of rise or the number of times of fall of the data pulse applied to said first electrodes, and

calculating the ratio of said detected number of times to the maximum number of times the data pulse can rise or the number of times the data pulse can fall, lowering, when said ratio is more than a predetermined ratio value, the potential at said first node to a predetermined voltage value, and then controlling the operation of said application circuit such that said first node is grounded.

21. The method of driving the display device according to claim 20, wherein said predetermined ratio value is not less than 95 %.

22. The method of driving the display device according to claim 19, wherein said predetermined value is more than one-second said first power supply voltage and is not more than four-fifth said first power supply voltage.